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THE WATER DISTRIBUTION SYSTEM OF INDUSTRIAL HOUSING PROJECTS FOR SHIPBUILDERS[1]

By William H. C. Ramsey[2]

Of the many industrial activities undertaken by the government and occasioned by our forced entry into the world struggle, in the interest of humanity and right, none stands more prominent than our wonderful record in the building of ships. Late in the fall of 1917, following the decision of the government to build a veritable bridge of ships across the Atlantic Ocean, the United States Shipping Board, Emergency Fleet Corporation, was organized and its accomplishments have become history. Scarcely had the necessary legislation been enacted, before contracts were negotiated and consummated, to adequately fill the demand for ships for the transportation of our troops and equipment and of supplies for our allies, as well as our magnificent army. In order to meet this demand for ships and to promote rapid accomplishment, many existing shipyards were expanded and many others were created new.

The larger and established yards are located in sections where other industrial growth had already produced a congested population, while the smaller or newer yards are situated near small communities, where the demand created for shipbuilders far exceeded any previous provisions for housing or transporting American workmen. The former condition is notably illustrated in the Delaware River district, the Clyde of America (fig. 1), where, prior to the war, the industry produced more ships than any other district in America. It was natural that these yards, so wonderfully equipped, should be the first to be expanded. Other industries in this section had previously enlarged their plants and greatly increased their forces to meet the war demands of the Allies, and as a result of this influx of workers, the demand for houses created a congestion of serious nature. Men slept, as well as worked, in three shifts and men with families could not even find livable quarters, not to mention satisfactory or suitable ones, in the vicinity. It was immediately evident that transportation and house construction were vital elements in the prosecution of shipbuilding. Accordingly in December, 1917, a housing department of the Emergency Fleet Corporation was established under the Division of General Service, with J. Rogers Flannery of Pittsburgh as executive head.

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[1] Read before the Buffalo Convention, June 12, 1919. Discussions of this paper are requested and should be sent to the Editor.

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The early activities were concerned chiefly in studying housing conditions in the vicinity of the shipyards, their adequacy and the means of securing maximum occupation. It was soon realized, that additional housing development was urgent and also, that much relief could be attained through a betterment of transportation, so that families could be housed at some distance from the yards and carried to their work by trolley and train. The scope of the work necessitated a larger organization and on April 3, 1918, the Passenger Transportation Service Section was established, under the same executive head, to study, develop and extend the available systems of transportation and to improve and increase the service.

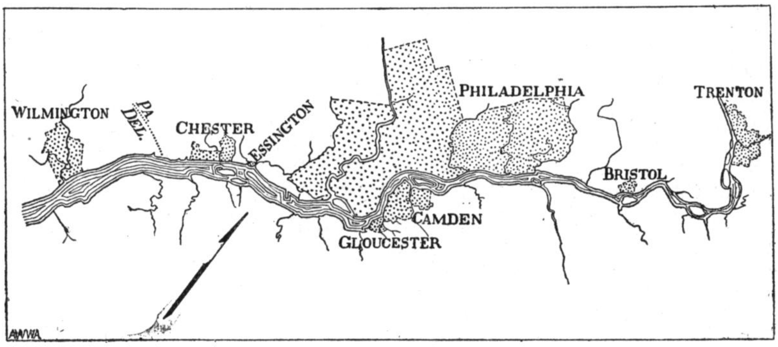

Fig. 1. Part of Delaware River Called "The American Clyde"

Under an act of Congress approved March 1, 1918, $50,000,000 were appropriated and the United States Shipping Board, Emergency Fleet Corporation, was authorized and empowered to purchase, lease, requisition or otherwise acquire and to sell or otherwise dispose of, improved or unimproved land, houses and buildings, and for other purposes. This appropriation was later increased to $75,000,000. under an act approved July 1, 1918, which provided for appropriations for sundry civil expenses.

Under the Housing Section designs were completed and contracts let during April and the early part of May, 1918, for housing projects at Hilton, Newport News, Va.; Hog Island Dormitories, 94th Street and Tinicum Avenue, Philadelphia; City of Camden, N. J.; Yorkship Village, Haddon Township, Camden County, adjoining Camden, N. J., and St. Helena, Md.

On May 7, 1918, the Housing Department and Passenger Transportation Service Section were merged into the Division of Passenger Transportation and Housing under A. Merritt Taylor, Director. The activities of this branch of the Fleet Corporation have since continued under this Division and since February 1, 1919, J. Willison Smith has been executive head with the title of Manager.

The jurisdiction of the Division included:

1. The determination upon and establishment of such necessary measures as would relieve the difficulties in passenger transportation and deficiency in facilities of transportation companies serving the various shipyards that hold contracts with the Emergency Fleet Corporation.
2. The determination of housing developments required to expedite ship construction, and the designation of character of houses and the establishment of same.
3. The securing of necessary land, property, franchises and facilities required for the above purposes, by purchase, condemnation or other means.

At the same time that the Division of Passenger Transportation and Housing was established, an additional sum of $20,000,000 was appropriated by Congress for transportation purposes only.

ORGANIZATION OF HOUSING DIVISION

The Housing Department of the United States Shipping Board, Emergency Fleet Corporation, under an executive head designated first as Director and later Manager, functioned through a Production Bureau, composed of an administration section and three major divisions; the Branch of Design, which handled the town planning and architectural features, the Engineering Branch, which regulated the design of utilities and street improvements, and the Construction Branch which supervised the construction of the complete building and utility program. Morris Knowles of Pittsburgh was chief engineer of the Engineering Branch and it is largely due to his effort and skill that the program for municipal improvements and utilities was so successfully accomplished.

The first step in the promotion of a housing development is that of investigation into the need for housing, the available sites and the character, type and cost of houses and utilities.

Investigations and planning. Under the work of the Emergency Fleet Corporation, a shipbuilding company files a formal application for housing in the vicinity. An investigation committee is appointed, comprising usually a representative of the Property Branch, which conducted the negotiations for the acquirement of land and for the extension of the facilities of the local utility companies, and representatives of the Production Bureau, including a town planner, an architect and an engineer. This committee verifies the information submitted and makes a thorough investigation of the site, its location, accessibility and topography, looks into the facilities of the local utility companies and the municipalities, and submits a full detailed report, with recommendations. It frequently occurs that the report is a negative one, either as relating to the site itself or to the necessity for housing.

After it has been determined to proceed with the housing program and the site has been accepted and the number and character of houses determined upon, the Branch of Design, through a town planner, develops and presents a general layout. In the meanwhile, the Engineering Branch takes up its duties in the design of municipal improvements and utilities, coöperating with the town planner, so as to conform the town layout to the economical construction of municipal improvements.

Needless to say, with the large housing program which was undertaken, it was impracticable in the limited time and with an organization which would not be unwieldy, to handle the details of design for all the projects from a central office. The Division of Passenger Transportation and Housing, with its underlying branches, therefore acted as a central organization or a clearing house, which regulated the design and through which all designs had to pass for approval. Each local project was represented by a town planner, an architect and an engineer, who were appointed by the respective branches of the central organization. Their qualifications, organization and past record in the prompt expedition of work and in the management of large undertakings were carefully investigated and governed their appointment. The engineer on this work was designated Local

Project Engineer. The Engineering Branch supervised the work broadly comprehended by the terms "municipal and utility engineering." Instructions for the preparation of plans and standards of design were prepared and submitted to the retained or local project engineers, who were directed to prepare plans for the approval of the Engineering Branch.

Water supply investigations. Immediately after the site was selected, a complete investigation was made of all convenient sources of water supply. Investigation was made and assurance received that the water was clear and free from sediment at all times, did not contain any objectionable mineral constituents, and was entirely safe from a sanitary standpoint. Before reaching a decision upon the purity and potability, studies were made of past health records, typhoid rates, water analyses, and any other pertinent data and evidence that could be obtained and would lead to a conclusion. It was insisted that the supply should be abundant and wholesome, even though extensive changes in local practice and standards were necessary.

Alternative studies were made, either for extending the existing private or municipal systems or for obtaining water from an independent source. An intimate knowledge of the local water supply and distribution system, therefore, had to be gained, before definite plans for the introduction of water into a project could be devised. In order to expedite the installation and to keep the cost low, efforts were made to obtain ample supplies, not only for the domestic but for fire protection purposes through a gravity system. It was usually found, however, that the supply lines had to be reinforced and the source of supply strengthened to meet the requirements of quantities and pressures, although, in most instances, the location of the projects was such that existing facilities could readily be extended to meet the demands. Where the pressures were insufficient, consideration was given to booster stations, elevated storage tanks and portable fire fighting equipment, and a decision was rendered on the basis of initial cost, maintenance and operation.

In all cases, provision was made for good circulation by the use of a gridiron system, with all dead ends eliminated. Very careful attention was given to economical layout, not only in the determination of pipe sizes, but in the arrangement of valves and hydrants. The character of service pipe and the methods of installation were adapted to local practices, but a $\frac{3}{4}$-inch service was adopted as the minimum permissible size. All services were provided with curb cocks.

General water supply requirements. General requirements for quantities and dependability of supply were governed and fixed by the type and size of the development and the character, size and grouping of the houses. In the printed instructions issued to the Local Project Engineer, certain governing considerations were set forth for his guidance, with stress laid on available quantity and quality. In the determination of quantity, the consumption of the additional population to be supplied was rated at 100 gallons per capita. As a guide in determining the supply required for fire protection, the instructions suggested that it should be computed on the basis of million gallons per day equivalent to the square root of the population in thousands. For instance, if the population to be housed was 9000, the allowance for fire service would be at the rate of 3,000,000 gallons per day, in addition to the average domestic consumption.

It was also stipulated that no pipe smaller than 6 inches in diameter should be used in the distribution system, although it was recognized that 4-inch pipe could be used for a cross-connection in a residential street where there would be no future necessity for placing a hydrant. As regards quality, the standard of purity, as previously indicated, was to be adhered to, and studies for the introduction of water were based on this information. The pressure standard was also indicated, and while it was appreciated that the housing development was largely residential, high business or other public buildings might occur in the future; and instructions were issued to provide fire protection capable of being increased, if future growth so demanded. A minimum of 40 pounds was placed as the lowest desirable domestic fire pressure, with pressures of 50 to 60 pounds where possible, and even higher pressures in special locations. Where the desirable pressures, through extensions of the municipal or private systems, did not obtain, the Local Project Engineer was to arrange for a means of temporarily raising the pressure to 60 or 70 pounds; with 80 to 100 pounds as the minimum desirable for business districts. Provision was made for the proper fire pressures and quantities through ample pumping machinery and sufficient suction storage, and by elevated tank or reservoir of adequate capacity.

Cast iron pipe was generally specified for the distribution system. Wood stave pipe was to be considered for long lines or large pipe in special cases. Steel pipe was to be avoided, as this material was so badly needed for other war uses. Hydrant spacing was stipulated, so that pressure losses through fire hose were kept at a minimum. The usual setting was to place the hydrants at intersections, except in long blocks, where an intermediate hydrant was to be placed. A normal spacing of 300 feet was requested, with 400 feet as a maximum. In layouts, where the sub-division was not uniform, it was required that the hydrants should be placed so as to cover 90,000 to 100,000 square feet of territory.

Figure 2 shows the cross-sections taken at several of the housing projects, and is introduced to show the variations in the location in streets and alleys, of water and gas mains, sewers and electric pole lines.

It was stipulated that valves should be liberally used and so placed that ordinarily not more than three blocks of pipe would be thrown out of service when control valves were closed. Large mains up to 18 inches in diameter should have valves from ¼ to ⅜ mile apart. All pipes connected to larger mains should be valved, and smaller pipes, 4-inch to 10-inch, should be valved at least every ¼ mile. Valves on hydrant branches were to be omitted, except where the main was 10 inches or larger, or where local practice had to be followed.

It was specified that house service pipe under all highways should be best quality, extra strong lead pipe, laid from main to curb cock. The extension of the lead pipe into the dwelling was recognized as being desirable and preferable. Under warranting conditions, galvanized lead-lined pipe or galvanized pipe could be used. Great weight in determining the class of material that would have a reasonable life under local conditions was laid upon local practice and the experience of the local water works companies.

A general policy of metering was adopted by the Housing Department, with the meter installed either at the curb in frost-proof boxes or in the cellars, dependent upon local conditions.

The necessity for water supply and fire protection was created upon the inception of building construction and the demands grew daily with the increase in the force of workmen and with the growth of building construction and consequently the fire hazard. In many cases, the construction of new supply lines and the installation of booster pumps and other additions for storage of supply were required and could not be readily installed, on account of delays in the delivery

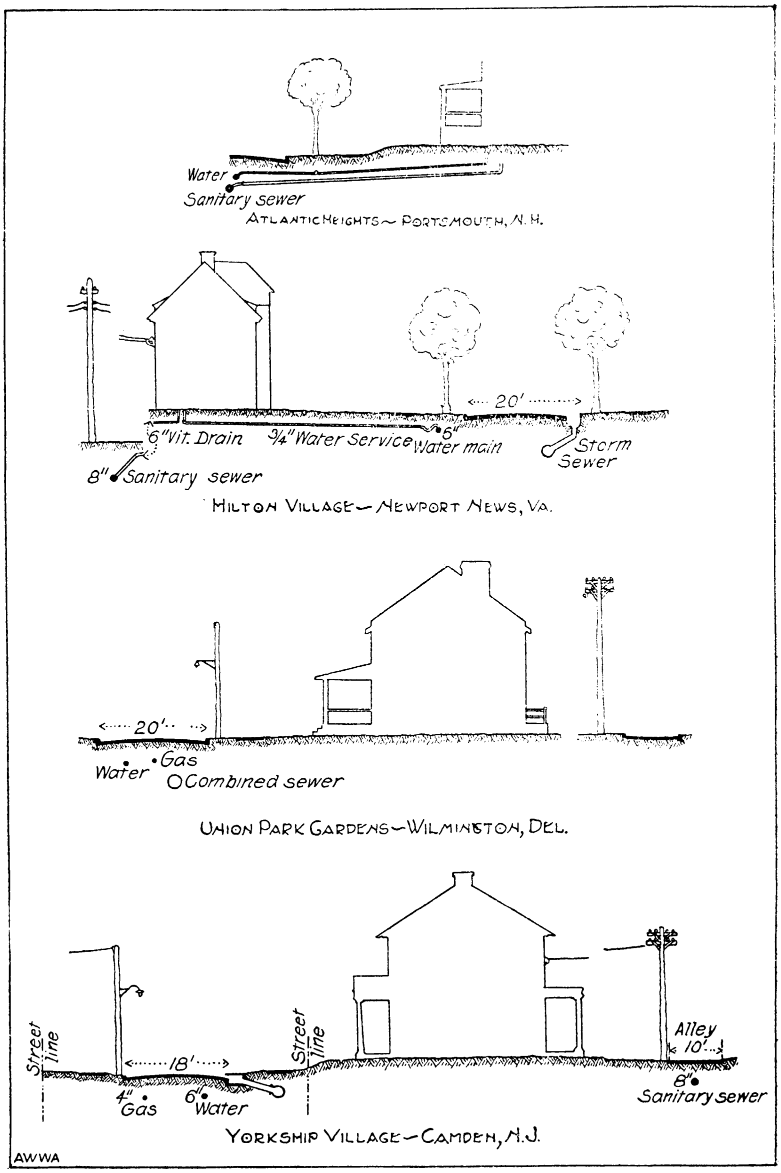

FIG. 2. VARIOUS LOCATIONS OF UTILITIES IN HOUSING PROJECTS.

of materials. It was, therefore, necessary to make temporary provision for fire protection, in advance of the complete permanent installation. So far as possible, the permanent distribution system was laid very promptly and immediately thrown into service; while in other instances portions of the permanent system were completed and connection made with a temporary system laid upon the ground. The extent of the temporary distribution system was determined by the size of the project, the location of the building construction and by the proximity of a water supply ample for construction and fire protection purposes. It frequently occurred that temporary supply lines were laid on the surface and connected with the existing terminals of the municipal or private systems and occasionally temporary booster stations were provided.

Promptly after the authorization for the construction of a housing project, negotiations were entered into by the Property Branch with the municipal authorities or private company, for the extension of its plants and facilities. Financial assistance by means of loans was rendered when necessary.

The Engineering Branch coöperated with other divisions of the Emergency Fleet Corporation and, in the determination of quantity and pressure of water for fire protection purposes, was constantly in touch with the Fire Protection Section of the Shipyard Plants Division. This section was supervised by representatives of the National Board of Fire Underwriters. The Engineering Branch also coöperated with the Insurance Section of the Finance Division under which there was a Fire Branch. This section looked into and placed insurance on all buildings connected with the housing projects.

As soon as the Local Project Engineer presented his preliminary layout of the water distribution system and his supporting data, a conference was immediately called for the determination of the minimum requirements of quantity and pressure. In these conferences, representatives of the departments previously mentioned were in attendance. From studies of the character and type of houses, their arrangement and grouping, pressures and quantities, proximity of fire fighting apparatus and the possibility of its installation on the project, after thorough discussion, a conclusion was reached regarding the necessary quantities and pressures for the particular project and what provisions, if any, should be made for increasing the pressures. The distribution systems were examined not only from an engineering standpoint but also from the point of view of the Board of Fire Underwriters and the insurance companies.

AUTHORIZED PROJECTS

In all a total of 24 projects were authorized and of these 19 were constructed under the direct supervision of the Passenger Transportation and Housing Department. Under the complete program 28,064 shipyard workers can be housed and the number of employees at the yards affected by the housing is about 150,000. In magnitude, the projects range from 42 houses at Groton, Conn., and 79 houses at Wyandotte, Mich., to approximately 1900 at Camden, N. J. The average is about 250 houses. Table 1 gives a list of the constructed projects, and their geographical location.

The apportionment of houses for shipworkers' use and the number of persons for whom accommodations are provided include:

	persons
8644 houses and 2 boarding houses	43,459
849 apartments	4,245
94 dormitories	6,174
5 hotels	1,430
Total	55,308

The estimated cost of the projects is about $70,000,000 and of this amount, approximately one-fourth to one-fifth is required for the construction of street improvements and public utilities.

WATER DISTRIBUTION SYSTEMS

Bath, Maine. The project is located in the northern part of the city, within the city limits and on the western bank of the Kennebec River. The water is obtained from the Bath Water Department.

Originally, it was planned to develop a system for a delivery rate of 1500 gallons per minute, but afterwards this was reduced to a delivery of 1200 gallons per minute, at 54 pounds pressure, to the limits of the project. The distribution system is designed to deliver 1000 gallons per minute, under a hydrant pressure of 47 pounds. The city fire pumping equipment is available for use on the project.

The water mains in this section of the city were very small, and in order to secure the deliveries as above stipulated, under the required pressures, an existing 4-inch main was replaced with a 12-inch main 1900 feet long and connected into an existing 10-inch

TABLE 1

Constructed housing projects of the Emergency Fleet Corporation

PLACE	BUILDINGS	PERSONS HOUSED	SOURCE OF SUPPLY	FIRE SUPPLY	HYDRANTS	
					Number	Gates
				gals. min.		
North Atlantic District						
Bath, Me.	109 houses 4 dormitories	290	City	1200	12	Yes
Portsmouth, N. H.	278 houses 9 dormitories	965	City	1000	19	Yes
Groton, Conn.	92 houses 7 dormitories	433	Borough	1000	18	No
Newburgh, N. Y.	127 houses 70 apartments	374	City	1200	17	Yes
Port Jefferson, N. Y.	9 houses 1 dormitory	224	Private	500	4	Yes
Delaware River District						
Hog Island, Pa	16 dormitories	2042	City	2000	22	No
Essington, Pa.	200 houses	400	Private*	1000	11	Yes
	1 dormitory	641	Private*	500	3	Yes
Chester, Pa.						
Sun Village	430 houses 56 apartments	860	City	1500	22	No
Sun Hill	282 houses	568	City	1000	13	No
Buckman Village	278 houses 22 apartments	876	City	1500	20	No
Chester Hotel	1 hotel	292	City	City	6	Yes
Wilmington, Del.	503 houses 7 apartments	1020	City	1500	32	Yes
Camden, N. J.						
1st Haller	100 houses	200	City	City	10	Yes
Morgan Village	92 houses 1 apartment	190	City	City	10	Yes
Yorkship Village	906 houses	3312	City	1500	106	Yes
Fairview Extension	480 houses 4 apartments 1 hotel					
Gloucester, N. J	447 houses 1 apartment	896	City	1500	36	No

TABLE 1—*Concluded*

PLACE	BUILDINGS	PERSONS HOUSED	SOURCE OF SUPPLY	FIRE SUPPLY	HYDRANTS	
					Number	Gates
				gals. min.		
Chesapeake Bay District						
Newport News, Va.						
Hilton Village	473 houses	946	Private	1500	26	No
Washington Apartments	4 apartments	421	Private			
Dundalk, Md.	529 houses 2 boarding houses	1100	Private Private	1500	34	No
St. Helena, Md.	296 houses	1848	Private	1500	17	No
South Atlantic District						
South Jacksonville, Fla.	158 houses	316	City	1500	18	No
Great Lakes						
Lorain, Ohio	232 houses 8 apartments	480	City	1500	18	Yes
Wyandotte, Mich.	79 houses	158	City	1000	7	No
Manitowoc, Wis.	100 houses 1 dormitory	500	City	1500	8	No

***Fire protection of the Essington Dormitories is furnished by the industrial water works of the Westinghouse Company, which is able to furnish 500 gallons a minute at 30 pounds hydrant pressure or 1000 gallons at 22 pounds.**

main, with lateral feeds of 4-inch and 6-inch. On the project, the 12-inch main branches into three short 8-inch mains, and all other mains are 6-inch.

Portsmouth, N. H. The project is located within the city limits on the Piscataqua River, about 1 mile upstream from the business center, and ½ mile from the main highway between Portsmouth and Dover.

The water supply is taken from the city. The connecting main between the project and the city is small and would not permit of the requisite delivery of 1000 gallons per minute in addition to the domestic consumption. Furthermore, the location and elevation of the project in relation to the city is such that at times of excessive draught in the city it was feared that the water would not reach the project or, possibly, would be drawn from its distribution system. It was, therefore, concluded to provide independent storage on the tract and to install a motor driven centrifugal pump on the supply line at a lower elevation in the city. A steel tower and tank of a capacity of 100,000 gallons and a height of 100 feet was erected on the high ground to the southeast. The distribution system is designed for a delivery of 1000 gallons per minute with a normal pressure of 40 pounds, but a delivery of 1500 gallons per minute can be obtained by the use of fire fighting equipment with a reduction in pressure to 10 pounds.

An 8-inch main from the tower and tank is carried through the central street of the development to the public circle, at the northern extremity. All other street mains are 6-inch.

Groton, Conn. The project is located in a sparsely settled area, tributary to Groton and New London. The water supply is obtained from the Borough of Groton, which is improving the works. Under improved conditions, there can be delivered through the distribution system a fire flow of 1000 gallons per minute under a pressure of 35 to 40 pounds at the hydrant. An 8-inch main is carried on the north and west boundary streets, and all other mains are 6-inch.

Newburgh, N. Y. This project is located within the outlying section of the city.

The water is obtained from the city, which is planning improvements of its works. In order to obtain a satisfactory supply, it was necessary to reinforce the city gridiron system by the installation of an additional section of distribution main and the enlargement of a section of small main. The distribution system was designed for a delivery of 1200 gallons per minute under hydrant pressure of 45 pounds, although this delivery cannot be obtained until the contemplated improvement in the water supply is made and a large supply main is constructed to the site.

Port Jefferson, N. Y. This project is located in the southern section of the village of Port Jefferson, on the northern shore of Long Island. Water supply is obtained from the Port Jefferson Water Company. The design of the distribution system contemplates the delivery of 500 gallons per minute under pressure of 44 pounds at the hydrant, through a 6-inch main to the site. All water delivered is measured by a detector meter placed on the branch main to the dormitory. It was desired to have a second supply main, but it was felt that the expense did not justify the installation.

Hog Island, Pa. This project is located in southern Philadelphia about ½ mile from the Hog Island Shipyards and just west of the junction of the Schuylkill and Delaware Rivers.

The water supply is taken from an existing 12-inch city main, augmented by what is termed a 48-inch express main, laid into the district immediately after the construction program at Hog Island Shipyard was started. Pressures in the district prior to the installation of the express main were 27 pounds, and after the installation of the main, 44 pounds. The distribution system was designed for fire flows of 2000 gallons per minute, with minimum hydrant pressures of 20 pounds, on the basis that fire fighting apparatus would be used. All piping is 6-inch, and three connections were made to the 12-inch main. The supply to the buildings is metered through one meter for each group of four dormitories.

In this section of the city many houses, providing accommodations for 3978 men, were built under the direction of Admiral F. T. Bowles, Assistant General Manager of the Emergency Fleet Corporation.

Essington, Pa. This project adjoins the turbine plant of the Westinghouse Electric and Manufacturing Company, at Essington, Pa., along the Delaware River, about 4 miles from Chester and 8 miles from Philadelphia. Two projects were constructed, one known as Essington Dormitories, one known as South Philadelphia project.

Domestic water supply for both projects was obtained from the mains of the Springfield Consolidated Water Company, which had previously been laid in Essington and Lester. From this system there was available at the site a static pressure of 60 pounds, yet, on account of the small mains, a fire draught of only 500 gallons per minute at a pressure of 42 pounds at the hydrant could be obtained. By reason of the growth in this district of the many industries engaged in the war emergency, the facilities of the water company were entirely inadequate. A loan was arranged with the United States Housing Corporation by which the water company reinforced its system by the addition of a large main, and it is estimated that 1000 gallons per minute can be delivered at a pressure of 42 pounds.

The distribution system was designed for flows of 1500 gallons per minute at a minimum hydrant pressure of 20 pounds, on the basis that fire fighting apparatus would be used and provided. An 8-inch main leads along the southern and eastern boundaries of the development, and all other mains are 6-inch.

Fire protection for the Essington Dormitory was furnished from the plant of the Westinghouse Company, and connection made to a 20,000 gallon tank on a 75-foot steel tower. The supply is taken from the Delaware River and pumped into the tank without treatment. An 8-inch main leads from the tank and passes centrally through the dormitory tract, while 6-inch branch mains supply the sprinkler system and hydrants. The system will deliver 500 gallons per minute at 30 pounds at the hydrant, 750 gallons per minute at 26 pounds, or 1000 gallons at 22 pounds.

Chester, Pa. There are four projects here; two for the Sun Shipbuilding Company, which for all practical purposes can be rated as one project, as they lie on either side of the Baltimore & Ohio Railroad and are located in the eastern section of the city, and two for the Chester Shipbuilding Company, one known as the Chester Hotel adjacent to the Chester Shipbuilding Company and one known as Buckman Village, located on the western boundary of the city.

Sun Village. The distribution system consists of a 12-inch main through the most westerly streets of the project, with an 8-inch loop line extending eastward into the central streets. All other mains are 6-inch. In order to secure adequate deliveries from the existing city distribution system, a 12-inch main 1600 feet long was laid. In most parts of the project a fire flow of 1500 gallons per minute with hydrant pressures of 40 to 45 pounds are obtainable, but in one section only half this quantity at 35 to 40 pounds is available.

Sun Hill. This project is supplied through an 8-inch main extended from Sun Village.

The distribution system will yield deliveries of 1000 gallons per minute under pressures of about 40 pounds. In both of these projects the city will furnish fire fighting apparatus, which is stationed about ¾ mile west of Sun Village. The mains are adequate to deliver 1500 gallons a minute under these conditions.

Buckman. The supply is taken through a 12-inch pipe from a 12-inch existing main about 550 feet north of the project. This feed enters the northwest corner and divides into 8-inch and 6-inch, with an 8-inch main extending through the central street of the project and tying into an existing 8-inch main at the southern border. There are two short runs of 8-inch main extending westward from the central 8-inch main. The valving of distribution main will not put more than two hydrants out of service for any shut-off. The system is designed for deliveries of 1500 gallons per minute under hydrant pressures of 45 pounds.

Wilmington, Del. The project is located in the southwestern section of the city, and was incorporated through the extension of the limits of the city. The water supply is taken from the municipal system. The distribution system is taken from existing 12-inch mains on the north and east boundary streets. An 8-inch loop main is carried on the south and west boundary streets, and an 8-inch cross main leads through the central portion of the project. All other mains were 6-inch. The design contemplates a delivery of 1500 gallons per minute, with pressures of 40 to 45 pounds at the hydrant. At this project it is worthy of note that the size of the distribution system presented by the city water department was reduced, and smaller sizes placed in practically all streets.

Camden, N. J. The housing developments at Camden consisted of four projects. Two, the first Haller and Morgan Village, are located within the city limits. Two, Yorkship and Fairview Extension, were located originally in Haddon Township, about ¾ mile south of the city limits. In reality Fairview Extension is an extension of the Yorkship project, and both were later taken into the corporate limits of the city of Camden.

The supply for Yorkship Village was taken from an existing 24-inch city main through a 20-inch main about 9200 feet long to the project at the central square, as shown in figure 3.

Fire fighting equipment is available from the city of Camden, and a new fire station is under construction in the southern limits of the city immediately north of Yorkship Village. It was concluded, that with fire apparatus available, there should be delivered 1500 gallons per minute at 20 pounds pressure, in addition to the draught for domestic consumption. The 20-inch main will deliver at 20 pounds at the central square, but with such low pressures available, it was not possible to obtain this delivery on the outskirts of the village. On the western border 1050 gallons can be delivered and on the southern border 1500 gallons, at 10 pounds at the hydrant.

The problem of water supply for this development has not been permanently solved, as future draught upon supply lines, together with the fact that there is some doubt regarding the future quality of the water with respect to foreign matter, may require considerable modification in the adopted plan of supply, and may involve, at some future time, aeration, filtration and pumping. The water in this district contains much iron, which oxidizes rapidly upon exposure to the air and causes a deposit in the distribution system.

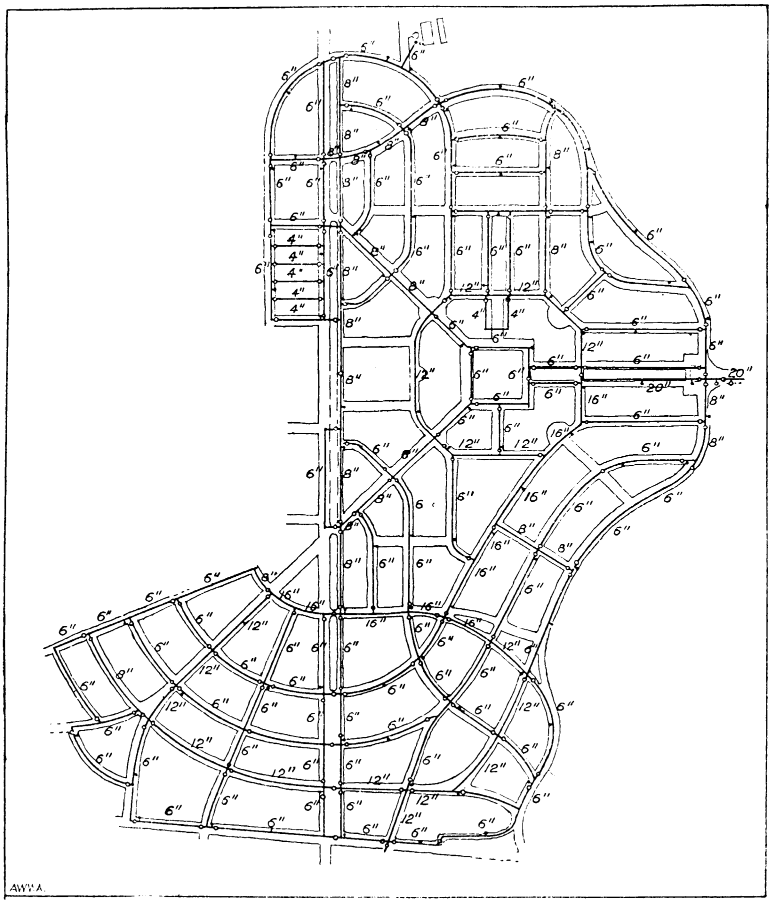

FIG. 3. DISTRIBUTION SYSTEM, YORKSHIP VILLAGE, N. J.

The question of water supply during construction was a serious one, and was temporarily cared for by a connection to the supply main of the General Water Supply Company, in Collingswood, and was brought in, over the surface, in screw joint pipe, and carried across the center of the project to the western end, where building construction was advancing most rapidly. A design for temporary gridiron distribution system, with connections for fire protection, was developed for the entire project, and was provided for by using 2 to 4-inch screw joint pipe, laid on the surface. Permanent installation in the western portion of the project, where the greater number of houses were under construction, was expedited so as to confine, as far as possible, the laying of temporary lines to the eastern portion. As soon as the permanent mains were laid and tested, they were thrown into service, so as to secure the benefits derived from larger quantities of water, and to replace the temporary system already installed. The installation of the permanent distribution system progressed rapidly, and soon covered an area beyond that occupied by houses under construction, thus eliminating the requirement for the temporary water line. To provide for heavy drought during short periods and to afford more uniform pressure in the distribution system, a temporary wooden tank of 25,000 gallons capacity was erected on a 75-foot tower and connected directly to the supply main. A small storage was thereby provided for fire purposes.

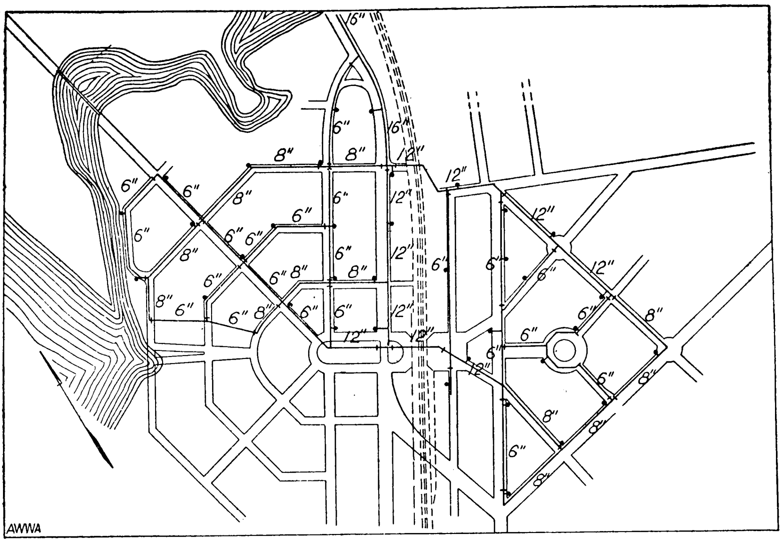

Fig. 4. Distribution System, Gloucester, N. J.

Gloucester, N. J. This project, figure 4, is situated south of the city limits on a peninsula between two branches of Timber Creek, and the water supply is obtained from the municipal plant of the city. In order to secure adequate quantities and pressures, it was necessary to lay an independent 16-inch main, 7000 feet long, between the Gloucester pumping station and the project. Connections were so arranged at the pumping station, that the domestic consumption could be cared for by the existing supply facilities. Fire protection can be furnished directly through this main by a high pressure pump, which is to be installed in the pumping station and held in reserve for this purpose.

The distribution system is designed to yield a fire flow of 1500 gallons per minute, in addition to the domestic consumption, with minimum pressure at the hydrant of 80 pounds and with a pressure of 100 pounds at the pumping station.

The 16-inch main is carried into the northern limits of the project, where it divides into two 12-inch mains, which extend southeastward and are looped together by an 8-inch main. Two 8-inch mains extend into the western side of the project and are connected by 6-inch cross mains; all other mains are 6-inch.

A temporary supply of water for building and fire protection purposes was obtained through a temporary main connected with the facilities of the Newbold and Westville Water Company. Screw joint pipe was laid over the surface of the ground, and as rapidly as permanent mains were constructed, they were tested and placed in service, thereby replacing the temporary water system.

Newport News, Va. The housing program at Newport News included two projects, one known as Hilton Village, located on the eastern shore of the James River about 3 miles from the city, and the other project, the Washington Avenue Apartments, in the city. The supply is obtained from the works of the private company which were greatly extended by the War Department.

The water supply for Hilton Village was taken from an existing 18-inch cast iron supply main, which passes the site. Pressures on the main at this point approximate 40 to 50 pounds. A centrifugal booster pump capable of delivering 2000 gallons per minute at a pressure of 80 pounds was installed on an 8-inch branch line leading from the 18-inch main. This pump is driven by a gasoline engine.

The distribution consists of a 12-inch main with 8-inch loop lines extending around the project and through the central highway. The cross mains are 6-inch.

Under the design 1500 gallons per minute can be delivered at any point on the project, under pressure of 50 pounds at the hydrant with pressure of 80 pounds at the booster station.

Dundalk and St. Helena. These two projects are contiguous and are divided by an electric railway from Baltimore to Sparrows Point. They are about 3 miles from Sparrows Point and 6 miles from the center of Baltimore.

On account of the isolation of the projects an independent water system had to be developed, although in St. Helena a water system comprising deep wells, pump, elevated tank and distribution system made up of 3 and 4-inch mains had been developed. This supply served admirably during construction and was augmented by laying screwed pipe over the surface and by the addition of fire hydrants, set temporarily. The facilities of the St. Helena plant were entirely inadequate as a source of supply and could not be developed and extended. It was, therefore, decided to secure the permanent supply from a point about 4000 feet from the developed area and a company was specially organized to install and operate the plant.

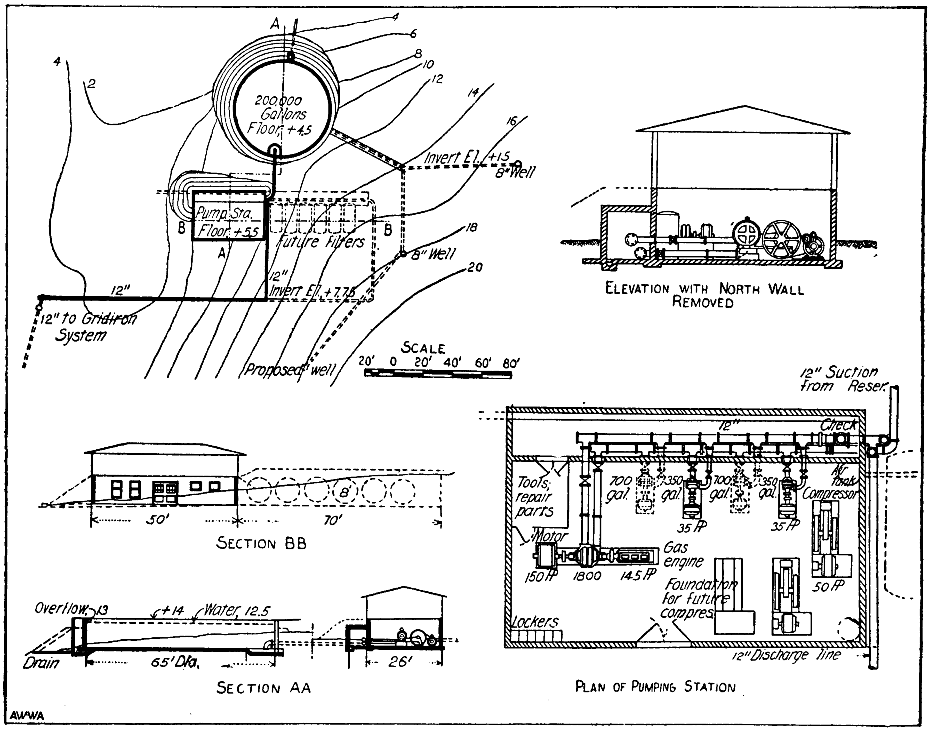

FIG. 5. PUMPING STATION, ST. HELENA AND DUNDALK, MD.

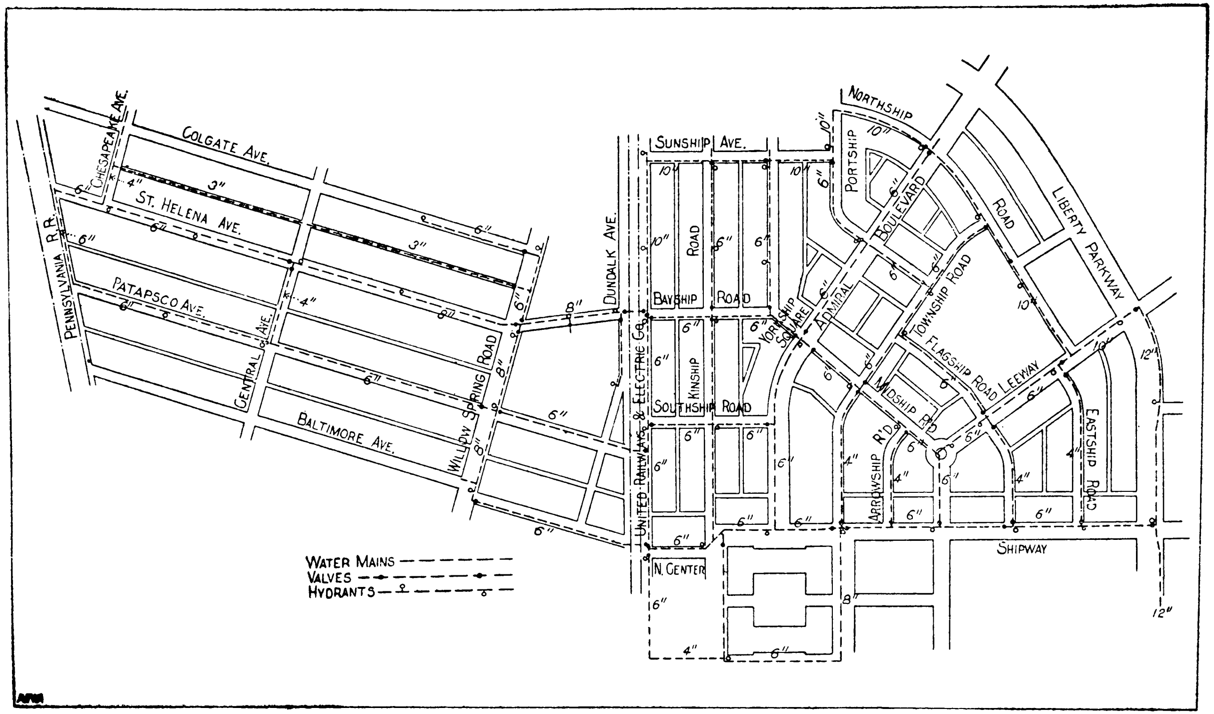

Fig. 6. Water Distribution System, St. Helena and Dundalk, Md.

Water is secured from driven wells, pumped by air into a concrete receiving reservoir of 200,000 gallons capacity, from which it is pumped by motor-driven centrifugal pumps through a 12-inch supply main to the projects. The station equipment, figure 5, comprises duplex domestic service pumps and a direct connected fire pump, arranged to be driven either by electric motor or gasoline engine. Pressure filters may be installed in the future if necessary.

The distribution system, figure 6, is designed to deliver 2000 gallons per minute under a minimum hydrant pressure of 20 pounds. The 12-inch force main enters the developed Dundalk area at the east and is reduced to a 10-inch main, which traverses the northern section and extends southward to a point opposite the St. Helena project. Eight-inch loop lines are carried from the 12-inch supply main in both the north and south sections of the developed area. The main supply for St. Helena is an 8-inch main carried to about the center of the project. A second supply enters St. Helena at the southeastern corner and loops back into the first. All other mains in both projects are 6-inch. Pressure tests conducted on the project indicate that a fire flow of 1200 to 1500 gallons can be obtained with pressure of 30 pounds in St. Helena and 40 to 50 pounds in Dundalk.

Savannah, Ga. The site of the housing development lies 7 miles up the Savannah River from Savannah and is adjacent to Port Wentworth, a small, recently developed community. The project was abandoned after the signing of the armistice and prior to active construction.

The water supply was to be obtained from a driven well on the property of the Terry Shipbuilding Corporation. The distribution system as designed provided for an 8-inch main, which was to enter the central diagonal street and a second 8-inch line which was to enter the project at the southeast corner. All other mains were to be 6-inch.

The distribution system was designed for fire flows of 750 gallons per minute, in addition to the domestic consumption with a pressure at the hydrants of about 30 pounds. With direct pressure, a flow of 750 gallons could have been obtained at a pressure of 78 pounds and a flow of 500 gallons per minute at a pressure of 90 pounds.

South Jacksonville, Fla. This project is located immediately south of the improved area of South Jacksonville. Water supply is taken from the existing municipal plant, which had to be enlarged to furnish an adequate supply. The city drilled a new 8-inch well, which afforded a flow of about 1000 gallons per minute, installed duplicate motor driven centrifugal pumps, of 750 gallons per minute each, changed their existing triplex pumps to motor drive, and constructed a new 95,000 gallon concrete reservoir and aeration basin. No treatment is given the water, as it is obtained from wells dug about 1000 feet deep, through sand.

Water is delivered to the project by a 12-inch force main nearly ½ mile long. This main divides at the project, figure 7, into a 6-inch and an 8-inch, which is carried across the center of the project. Six-inch loop lines are provided throughout and are cross connected by 4-inch mains where it was not necessary to install hydrants. The system is designed for fire flows of 1500 gallons per minute at pressures ranging from 50 to 60 pounds at the hydrant, with pressures at the pump of 100 pounds.

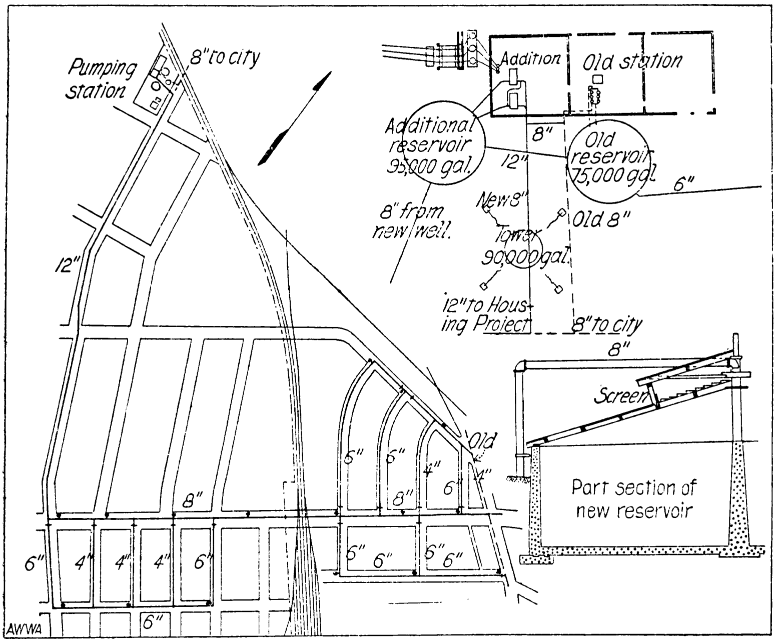

FIG. 7. DISTRIBUTION SYSTEM, SOUTH JACKSONVILLE, FLA.

Lorain, Ohio. This project is located in the northwestern section of the city, on the outskirts of the present built up area. The water supply is obtained from the city.

The distribution system was connected with a 12-inch cast-iron main previously laid to the northwesterly corner of the project and partially along the western border. This latter main was extended along the western and southern borders, where reduction was made to smaller sizes. Another 12-inch main was extended across the north of the project, with an extension into the central portion. Intermediate mains between the northern and southern portions are 6-inch.

The system is designed for fire flows of 1500 gallons per minute, under pressures of 45 pounds at the hydrant, when the pressure at the city pumping station is 90 pounds.

Wyandotte, Mich. The project is located in the southern section of the city. Water is furnished through extensions of the municipal system, which had previously been laid in the eastern boundary of the project. The mains in this section of the city are small and the pressure at the development is not entirely satisfactory. The entire distribution system consists of 6-inch pipe. The system will deliver 1000 gallons per minute at 30 to 35 pounds pressure and 1500 gallons can be secured at pressures of 25 to 30 pounds. Fire fighting equipment will be used at this project.

Manitowoc, Wis. This project is located north of the built-up section of the city, in the direction of residential expansion. The water supply is taken from the city.

The distribution system adjacent to the project is small and the available pressures were insufficient. A short section of 8-inch main was, therefore, laid in the distribution system, exterior to the project. All other mains are 6-inch. Hydrant spacing was held to 300 feet and on account of the very low pressure available, the system was so gated that a shut-off would not cut more than one hydrant out of service. Fire flows of 1500 gallons per minute can be obtained only under hydrant pressure of 20 pounds, and it is therefore necessary to use fire pumping equipment.

CONCLUSION

It is felt that the basic principles which guided the installation of the various water systems, especially the sizes of mains, arrangement of valves and the spacing of hydrants, will do much to raise the standards of construction in the neighborhood of the various projects, thereby resulting in a decreased fire hazard and in securing better service to the communities. In many cases great patience was necessary and carefully conducted negotiations were required, before some of the municipalities or private water companies could see the necessity of following the standards promulgated by the government. It is, however, pleasing to report, that, after thorough discussion, the officials of these municipalities and private companies agreed to and approved the requirements.